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PINE LAKE, WAUKESHA COUNTY, WISCONSIN.
EPA REGION V

Pacific Northwest Environmental Research
Laboratory

Prepared for:

National Environmental Research Center
Wisconsin Department of Natural Resources
Wisconsin National Guard

July 1975

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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REPORT
ON
PINE LAKE
WAUKESHA COUNTY
WISCONSIN

EPA REGION V

WORKING PAPER No. 72

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

JULY, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. This report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

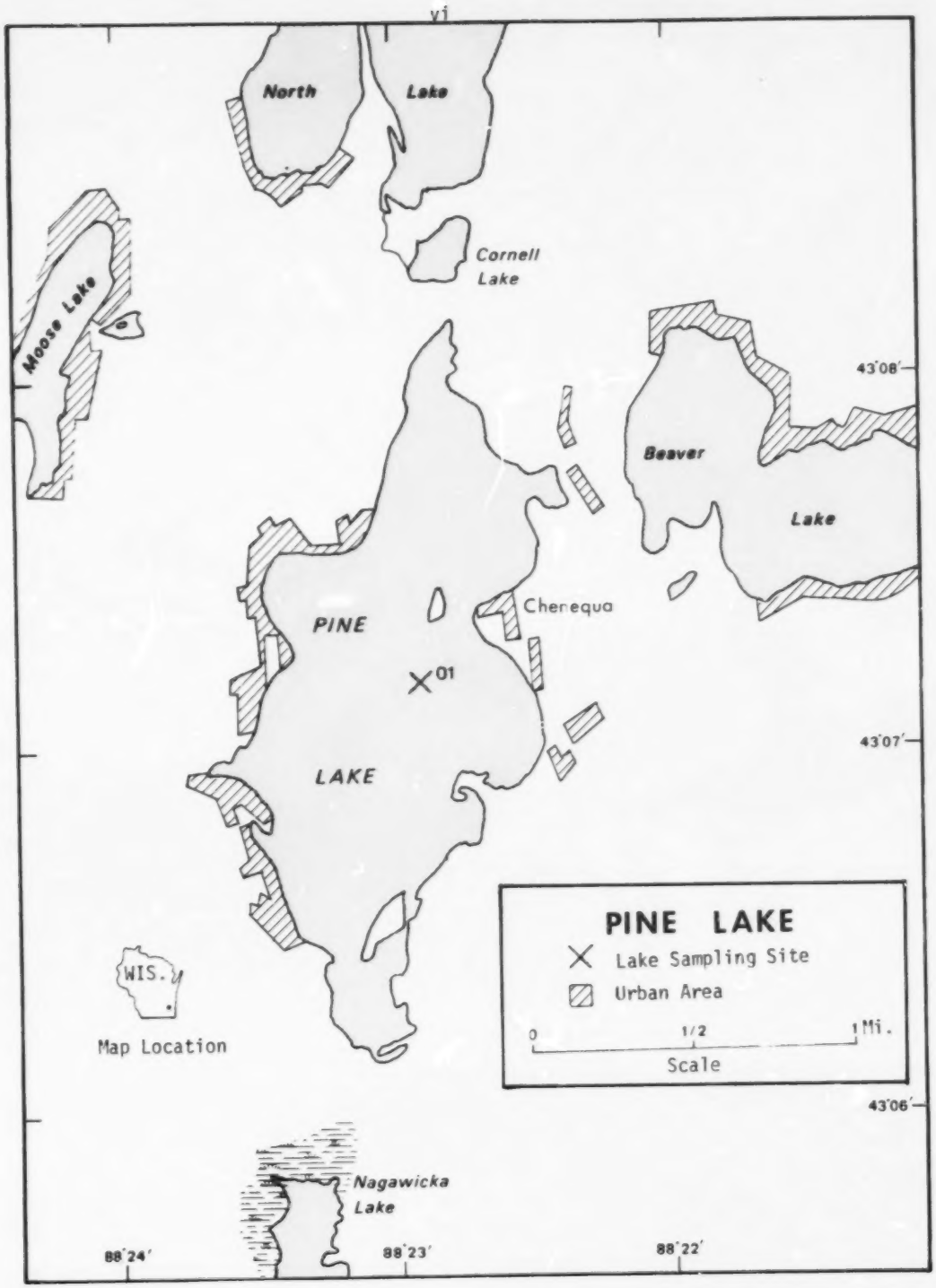
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


North
Lake
Cornell
Lake
Moose Lake
43°08'
Beaver
Lake
PINE
LAKE
01
Cherequa
43°07'
PINE LAKE
Lake Sampling Site
Urban Area
0
1/2
1 Mi.
Scale
WIS.
Map Location
43°06'
Nagawicka
Lake
88°24'
88°23'
88°22'

PINE LAKE

STORET NO. 5536

I. INTRODUCTION

Pine Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. No waste treatment plants impact the lake, and there are no well-defined tributaries. Therefore, this report relates only to the lake sampling data.

II. CONCLUSIONS

A. Trophic Condition:

Survey data and a report by others (Lueschow, et al., 1970) indicate Pine Lake is meso-eutrophic. Of the 46 Wisconsin lakes sampled, 11 had less mean total phosphorus, ten had less mean dissolved phosphorus, one had less mean inorganic nitrogen, 16 had less chlorophyll a, and 14 had greater mean Secchi disc transparency. Dissolved oxygen was somewhat depressed but not depleted in June and August (at 50+ feet in depth).

Pine Lake has had extensive aquatic weed and Chara sp. control programs (Lueschow, et al., 1970; Lueschow, 1972).

B. Rate-Limiting Nutrient:

The algal assay results indicate probable inhibition of test alga growth, and the results are not considered representative of

lake conditions at the time the sample was collected. Analysis of a portion of the assay sample showed a dissolved lead concentration of 20 µg/l, dissolved zinc of 8 µg/l, and dissolved arsenic of 164 µg/l; these elements may have caused the inhibited growth.

The lake data indicate nitrogen limitation at all sampling times. The mean N/P ratios were 4/1 in June, 10/1 in August, and 4/1 in November.

III. LAKE CHARACTERISTICS

A. Lake Morphometry*:

1. Surface area: 703 acres.
2. Mean depth: 38.6 feet.
3. Maximum depth: 85 feet.
4. Volume: 27,117 acre-feet.

B. Precipitation**:

1. Year of sampling: 38.7 inches.
2. Mean annual: 30.7 inches.

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* Ball, 1973.
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Pine Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll *a* analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 55 feet.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (11/09/72)		
Temperature (Cent.)	8.0	8.0	8.0	8.0
Dissolved oxygen (mg/l)	9.4	9.6	9.6	9.8
Conductivity (μmhos)	325	336	340	340
pH (units)	8.2	8.2	8.2	8.2
Alkalinity (mg/l)	141	146	148	150
Total P (mg/l)	0.028	0.028	0.028	0.029
Dissolved P (mg/l)	0.012	0.013	0.014	0.014
NO_2 + NO_3 (mg/l)	0.020	0.020	0.020	0.020
Ammonia (mg/l)	0.030	0.033	0.030	0.040
		ALL VALUES		
Secchi disc (inches)	18	72	79	120

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/21/72	1. Dinobryon	886
	2. Oocystis	90
	3. Flagellates	78
	4. Cyclotella	60
	5. Microcystis	60
	Other genera	217
	Total	1,391
08/19/72	1. Chroococcus	1,229
	2. Dinobryon	571
	3. Microcystis	448
	4. Anabaena	296
	5. Cosmarium	51
	Other genera	174
	Total	2,769
11/09/72	1. Anabaena	1,130
	2. Dinobryon	235
	3. Lyngbya	216
	4. Microcystis	171
	5. Flagellates	108
	Other genera	75
	Total	1,935

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/21/72	01	1.9
08/19/72	01	3.8
11/09/72	01	16.8

V. LITERATURE REVIEWED

Ball, Joseph R., 1973. Personal communication (lake morphometry). WI Dept. Nat. Resources, Madison.

Lueschow, Lloyd A., 1972. Biology and control of aquatic nuisances in recreational waters. Tech. Bull. No. 57, WI Dept. Nat. Resources, Madison.

_____, James M. Helm, Donald R. Winter, and Gary W. Karl; 1970. Trophic nature of selected Wisconsin lakes. Trans. Wisc. Acad. Sci., Arts & Ltrs., vol. 58, pp. 237-264.

Poff, Ronald J., and C. W. Threinen, 1963. Surface water resources of Waukesha County. WI Cons. Dept., Madison.

VI. Appendix

APPENDIX A

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

553601
43 07 12.0 088 03 00.0
PINE LAKE
55 WISCONSIN

11EPALES 2111202
3 0060 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/21	14 55	0000	17.7	10.2	18	265	8.70	144	0.010	0.030	0.012	0.010
	14 55	0015	19.8	10.5		265	8.70	143	0.010	0.030	0.014	0.011
	14 55	0030	7.5	12.2		275	8.30	148	0.020	0.030	0.034	0.016
	14 55	0055	5.4	7.6		280	7.60	149	0.030	0.040	0.029	0.012
72/08/19	16 50	0000			120	300	8.55	136	0.060	0.080	0.020	0.014
	16 50	0004	26.3	8.9		298	8.60	131	0.050	0.060	0.018	0.011
	16 50	0015	22.5	9.6		298	8.60	131	0.050	0.060	0.019	0.011
	16 50	0023	20.8	9.4		295	8.58	131	0.050	0.060	0.020	0.012
	16 50	0033	11.1	13.2		305	8.40	140	0.040	0.050	0.030	0.014
	16 50	0043	6.3	4.9		315	7.40	144	0.090	0.060	0.035	0.016
	16 50	0053	5.8	4.6		320	7.40	144	0.120	0.080	0.035	0.016
72/11/09	14 10	0000			79	340	8.20	148	0.020	0.030	0.029	0.012
	14 10	0004	8.0	9.7		335	8.20	149	0.020	0.030	0.028	0.012
	14 10	0015	8.0	9.8		325	8.20	143	0.020	0.030	0.028	0.014
	14 10	0025	8.0	9.6		340	8.20	141	0.020	0.030	0.029	0.014
	14 10	0045	8.0	9.4		335	8.20	148	0.020	0.040	0.028	0.014
	14 10	0050	8.0	9.6		340	8.20	150	0.020	0.040	0.028	0.014

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/21	14 55	0000	1.9J
72/08/19	16 50	0000	3.8J
72/11/09	14 10	0000	16.8J

J VALUE KNOWN TO BE IN ERROR